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A taxonomic study of *Dumortiera**

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The genus *Dumortiera* was proposed in 1824 by Nees von Esenbeck for the reception of *Marchantia hirsuta* Sw. This species, which dates from 1788, was based on specimens from the mountains of Jamaica. Subsequent writers have assigned to it, however, a wide geographical distribution, its reputed range including most of the moist tropical and subtropical regions of the earth with extensions into certain temperate regions. According to the records the other species which have been referred to the genus are more restricted in their range, some of them having been reported from only one or two localities. These additions are not numerous, as the following complete list of species, arranged chronologically, will show:—

- DUMORTIERA HIRSUTA (Sw.) Nees, 1824 (*Marchantia hirsuta* Sw., 1788);
- D. SPATHYSII (Lindenb.) Nees, 1838 (*M. Spathysii* Lindenb., 1829);
- D. IRRIGUA (Wils.) Nees, 1838 (*M. irrigua* Wils., 1833, *Hygropyla irrigua* Tayl., 1835);
- D. NEPALENSIS (Tayl.) Nees, 1838 (*H. nepalensis* Tayl., 1836);
- D. TRICHOCEPHALA (Hook.) Nees, 1838 (*Marchantia trichocephala* Hook., 1837);
- D. DILATATA (Tayl.) Nees, 1847 (*Hygropyla dilatata* Tayl., 1844);
- ASKEPOS BREVIPES Griff., 1849;
- DUMORTIERA DENUDATA Mitt., 1861;
- D. VELUTINA Schiffn., 1898;
- D. CALCICOLA Campbell, 1918.

From this list three species may be at once excluded; they do not belong to *Dumortiera* and have already been transferred to their proper positions by writers. The species in question are: *D. Spathysii*, which is now regarded as a synonym of *Clevea Rousseliana* (Mont.) Leitg.; *D. dilatata*, a synonym of *Monoclea Forsteri* Hook.;† and *D. denudata*, the type species of the genus

* Contribution from the Osborn Botanical Laboratory.

† Leitgeb (7, p. 312) was the first to recognize that *H. dilatata* was a *Monoclea* and not a *Dumortiera*. He called it *M. dilatata*, supposing that it was distinct from *M. Forsteri*. His conclusions, unfortunately, were not based upon a study of the type material of *H. dilatata* but upon later New Zealand specimens, and his idea of *M. Forsteri* (in the opinion of Stephani) was gained from the American *M. Gottschei* Lindb., rather than from the true *M. Forsteri*. The type specimen of *H. dilatata* in the Taylor Herbarium shows conclusively that the species is a synonym of *M. Forsteri*.

Wiesnerella Schiffn. and now known as *W. denudata* (Mitt.) Steph. The remaining species have been the cause of much confusion from the taxonomic standpoint, and this is especially true of *D. hirsuta*, *D. irrigua*, *D. nepalensis* and *D. trichocephala*. To give some idea of this confusion it will be sufficient to quote from the writings of Schiffner and Stephani, two of the most prolific hepaticologists of Europe.

Schiffner, in 1893 (9, p. 36), estimated the number of species of *Dumortiera* as six, without enumerating them by name. He suggested, however, that they might all be forms of *D. hirsuta*, to which he attributed a range extending throughout all tropical countries. Under *D. hirsuta* he included the var. *irrigua*, a plant of Ireland, the Pyrenees, Italy and the southern United States. In another paper (10, p. 275) published the same year, he listed the var. *irrigua* from Brazil. In 1899 (11, p. 387) he cited *D. hirsuta* somewhat doubtfully from Japan, the plants in question combining a densely papillose thallus with a bristly female receptacle. In 1900 (12, p. 25) he referred certain Javan specimens, which he had previously determined as *D. hirsuta*, to *D. trichocephala*, and stated that the true *D. hirsuta*, if it occurred in Java at all, must be much rarer than *D. hirsuta*. In 1902 (13, p. 274) he listed *D. irrigua*, this time as a species, from La Palma, one of the Canary Islands; and in 1909 (15, p. 482) he discussed the rhizoids of *D. irrigua* (in plants from Italy and Brazil) and of *D. hirsuta* (in plants from Java). He apparently now regards *D. irrigua* and *D. hirsuta* as distinct species and considers *D. trichocephala* a synonym of *D. hirsuta*.

Stephani's statements about the species in question leave an equally indefinite impression. In 1886 (17, p. 13; 18, p. 94), he listed *D. hirsuta* from the African islands of San Thomé and Fernando Po; in 1888 (19, pp. 280, 300), from the West Indian islands of Hispaniola, Porto Rico and Dominica; in 1892 (20, p. 177), from Costa Rica; in 1895 (22, p. 304), from the African districts of Kamerun, Kilimanjaro and Usambara, and also from Queensland and northern New Zealand;* in 1897 (23, p. 78; 24, p. 842), from Japan and the Hawaiian Islands. In 1894

* The New Zealand records seem to have been based on *D. dilatata* (see page 167, footnote); this species, for a time, was supposed to be a synonym of *D. hirsuta*.

(21, p. 6) he definitely recognized *D. irrigua* as a species, basing his observations on Italian material and emphasizing the impossibility of uniting it with *D. hirsuta*, and in 1897 (23, p. 78) he listed *D. irrigua* from Japan. In the same year (24, p. 842) he listed both *D. nepalensis* and *D. trichocephala* from the Hawaiian Islands. In his revision of *Dumortiera*, published in 1899 (25), he recognized the validity of *D. hirsuta* and *D. trichocephala* but included *D. nepalensis* and *D. irrigua* among the synonyms of *D. hirsuta*. This revision apparently represents his latest views. In it he restricted *D. trichocephala* to Asia and Oceanica, citing specimens from Tonkin, Birma, Java, Tahiti and Samoa, as well as from the Hawaiian Islands. He ascribed to *D. hirsuta* a much wider distribution, giving as localities many of those mentioned above and also the following: Mexico, Jamaica, Guadeloupe, Colombia and Brazil; Reunion; Nepal and Java; Tahiti; Ireland.

The divergent views of Schiffner and Stephani and the changes which these views have undergone are no more perplexing than some of the views advanced by other writers. They indicate that the characters distinguishing *D. hirsuta*, *D. irrigua*, *D. nepalensis* and *D. trichocephala* must be either untrustworthy or difficult to apply. The characters upon which *Askepos brevipes*, *Dumortiera velutina* and *D. calcicola* are based are likewise less satisfactory than might be desired and arouse the suspicion that variable and inconstant peculiarities have been too strongly emphasized. At the same time, as will be shown below, definite evidence has been presented that certain differential features may be transmitted from one generation to another, but whether these features are specific in value or merely indicative of varietal or racial differences is exceedingly difficult to determine. Even if they are regarded as specific, it must be admitted that the species of *Dumortiera* are much less clearly defined than those of most genera of the Marchantiaceae; they are little more than "small species," as this term is now employed in the literature of the bryophytes.

The characters most emphasized by writers, in distinguishing the various species of *Dumortiera*, have been drawn from the size and method of branching of the thallus; from the structural features of its upper surface; from the structure and configuration

of the receptacles; and from the size of the spores. These characters may be taken up in order.

In its general aspects the thallus presents great uniformity. It consists of a flat, strap-shaped structure, with more or less undulate margins, and clings loosely to the substratum. According to Ernst (4, p. 163; *pl.* 18, *f.* 1, 2; *pl.* 20, *f.* 18, 19) the marginal undulations tend to be more pronounced in *D. trichocephala* than in *D. velutina* and are often accompanied by irregular indentations, but these vague differences are neither constant nor of great significance. The differences in size which have been described seem likewise very uncertain, although Campbell, (2, p. 331) in his account of *D. calcicola* emphasizes the narrow thallus, measuring barely 5 mm. in width. Quoting again from Ernst (4, p. 162) *D. trichocephala* includes larger forms on the whole than *D. velutina*, the thallus attaining a maximum width of 3 cm., but it includes also forms which are no wider than those of *D. velutina*. The size seems to be very strongly influenced by external conditions.

The branching of the thallus is usually dichotomous but sometimes ventral. The sexual receptacles are terminal, the branches bearing them being variable in length and normally limited in growth. Not infrequently, however, a sexual branch innovates at the apex, the innovation growing in the same direction as the branch and broadening out from a stalk-like base. Such an innovation is usually found in connection with a male receptacle or a female receptacle which has failed to be fertilized; but even a sterile branch, the growth of which has been arrested in some way, is sometimes induced to innovate. Apical innovations in *Dumortiera* have commonly been regarded as somewhat abnormal, caused perhaps by unfavorable environmental conditions. In *D. calcicola*, where they occur more regularly, at least on sexual individuals, they give rise to jointed sympodial systems of very striking appearance and have been emphasized by Campbell (2, p. 334) as a specific peculiarity. Unfortunately similar sympodia have been recorded by Schiffner (10, p. 275) in specimens of "*D. hirsuta*" from New Guinea and by Ernst (4, p. 161) in specimens of *D. velutina* from Java, so that they are by no means confined to *D. calcicola*.

In its histological features the thallus differs strikingly from most of the other genera of the Marchantiaceae, since it lacks, either partially or completely, the usual dorsal epidermis and system of air-chambers. The simplification in structure which is thus exhibited is regarded as a derived condition, associated in some way with the usual moist and shaded habitat of the plants. By the earlier writers air chambers were supposed to be invariably absent. Taylor, indeed, in his account of *Hygropyla irrigua* (26, p. 391), described a system of branched and anastomosing lines (*rami*) on the upper surface of the thallus but did not intimate that there was any connection between these lines and chambers. Many years later Leitgeb (7, p. 308), working mainly on Taylor's species, confirmed his observations and showed that the lines were ridges, representing the boundary-walls of vestigial air chambers. In the vicinity of the apex he was able to demonstrate a short-lived epidermis with distorted pores and he noted that epidermal fragments or isolated cells sometimes persisted for a while on the boundary walls of older chambers. Close to the receptacles he observed the frequent occurrence of elongated papilliform cells in the spaces enclosed by the boundaries and pointed out the homology between these and the green cell-chains filling the air chambers of *Marchantia*.

In the forms which Leitgeb studied these papilliform cells seem to have been restricted to the vicinity of the receptacles. At any rate he made no mention of them in other parts of the thallus, and the figures which he afterwards published (8, *pl.* 8, *f.* 8-11) show a smooth superficial layer of cells. A few years later Spruce (16, p. 566) gave a detailed account of "*D. hirsuta*," based primarily on South American material and apparently found a very different state of affairs. According to his description the superficial cells are "papilloso-prominulae" and give the living plants a velvety appearance. If there were exceptions to this condition in any of his plants he did not allude to them. Goebel (5, p. 224, *f.* 63) described the surface of "*D. hirsuta*" in much the same way and figured the papilliform cells very clearly. Unfortunately he did not state the source of his material. He contrasted the species with an unnamed form from Ceylon, in which he found vestigial chambers but no surface papillae, this

form thus agreeing essentially with *D. irrigua*, as described by Leitgeb. Soon afterwards Campbell (1, p. 49), in specimens of "*D. trichocephala*," from the Hawaiian Islands, found neither papilliform cells nor vestigial chambers.

The descriptions of Leitgeb, Spruce, Goebel and Campbell thus record the following three types of surface in *Dumortiera*: (1) with both vestigial chambers and papilliform cells; (2) with vestigial chambers but without papilliform cells; (3) with neither vestigial chambers nor papilliform cells. When these types are clearly defined, as they sometimes are, they seem to yield excellent characters for the separation of species, although writers have expressed dissenting views regarding their value. Schiffner, for example, in his description of *D. velutina* (12, p. 26), emphasized the crowded papilliform cells as one of the features of the species, while Stephani claimed that such cells were present in all the species and that their persistence in *D. velutina* merely indicated a shaded environment. Coker (3, p. 226) explained the presence or absence of vestigial chambers in much the same way. In the vicinity of Chapel Hill, North Carolina, he found that plants of *D. hirsuta* growing in shaded, rather dry localities showed such chambers clearly, while plants in more exposed, wet localities were perfectly smooth; and he attributed these differences to environmental factors. Schiffner (14) criticized the views of Stephani and Coker. He maintained that the degree of development which the air chambers exhibited was not directly caused by the environment but that it depended upon inherited qualities. To support his statements he showed that "*D. trichocephala*" (with greatly reduced chambers) and *D. velutina* (with better-developed chambers and papilliform cells), often grew under exactly the same conditions in the primeval forests of Java and Sumatra and that both maintained their distinctive peculiarities. He showed further that plants of *D. velutina* from an almost dark well were exactly the same as those from sunny paths. His most convincing arguments, however, were drawn from plants which had been cultivated under identical conditions for about twenty years in the botanical garden at Prague. These plants represented *D. velutina* and *D. irrigua*, and their distinctive differences persisted unchanged.

Some of Goebel's recent observations (6, p. 628, 629) help to confirm Schiffner's deductions. He described a Brazilian *Dumortiera*, presumably a form of *D. hirsuta*, which lacked vestigial air chambers completely and found that none were formed even when the plants were cultivated under the same conditions as *D. velutina*, which developed its normal chambers and papilliform cells. He called attention to the fact that very young plants of *Marchantia* lack air chambers and he therefore interpreted the *Dumortiera* without chambers as a juvenile condition. In case air chambers are never formed there is simply, in his opinion, a persistence of the juvenile state. If air chambers are formed the presence or absence of papilliform cells indicates a greater or less advance beyond the condition without air chambers. In other words there are certain races or varieties or "species" of *Dumortiera* which are never able, even under the most advantageous of conditions, to advance beyond the state without air chambers, while other "species" can advance to various stages beyond this state. Goebel mentioned also a plant of "*D. hirsuta*," which gave rise to an adventive branch without chambers. Since "*D. hirsuta*," in his conception of the species, normally develops chambers, this branch was interpreted as a reversion to a juvenile state.

According to the writer's experience, although the three types of thallus are often distinctly marked, they are by no means invariably so. Even an individual thallus may sometimes bear crowded papilliform cells in an older portion and be smooth or nearly so nearer the apex; another may form vestigial air chambers for a while and then continue its growth without them. Such cases are further examples of reversions and indicate that these may be induced without the intervention of adventive outgrowths. The power to revert, which more or less advanced types thus clearly possess, complicates still further the conditions found in the genus and adds to the difficulty of defining specific limitations. If a form with crowded papillae represents a "species," a smooth form growing in the same area may represent merely a juvenile condition of the same thing or it may represent a "species" which can not advance. At the same time it must be admitted that smooth or nearly smooth states are the only ones which

occur over extensive areas, according to the information at hand. In Europe and Africa, for example, no forms with crowded papilliform cells have as yet been reported, although some of the plants have vestigial chambers while others have none. In such areas, therefore, the difficulties of distinguishing between forms with crowded papillae and smooth forms are eliminated, although the difficulties of distinguishing between forms with air chambers and those without them still remain. In the writer's opinion the latter distinction is less significant than the former, and it seems inexpedient at the present time to attempt to use it in the delimitation of species.

The receptacles of *Dumortiera*, which represent stalked branch-systems, have been repeatedly described (see, for example, Ernst, 4, pp. 173-178). The stalk of the male receptacle is extremely short but shows two rhizoid-furrows, agreeing in this respect with the much longer stalk of the female receptacle. The disc of the male receptacle is not clearly lobed and the antheridia are not arranged in radiating rows, although they clearly arise in acropetal succession. The disc of the female receptacle develops normally from eight to sixteen groups of archegonia on its lower surface. When the receptacle is young there are no distinct marginal lobes, but these become evident later on in case fertilization has taken place, the groups of archegonia being situated beneath the lobes. The involucre is thick and fleshy and shows a small apical opening; on its surface it bears scattered bristles. Similar bristles, which have been interpreted as modified rhizoids, occur on the upper surface of the disc, sometimes abundantly and sometimes sparingly, sometimes restricted to the marginal portions and sometimes more evenly distributed. Vestigial air chambers are not developed, and the surface-cells, although sometimes more or less convex, do not form papilliform outgrowths, even when the vegetative thallus forms them abundantly.

The features used in separating species have been drawn mainly from the female receptacle and relate more especially to the marginal lobes and the number and distribution of the dorsal bristles. According to Stephani (25) the receptacle of *D. trichocephala* is strongly convex and very bristly, while that of *D. hirsuta* is less convex, with the bristles confined to the marginal portions. He

describes further certain ridges or rays on the dorsal surface alternating with the lobes; these ridges branch by forking, the branches extending along the margins of the lobes. In *D. trichcephala* the branches are not connected in any way and thus leave sharp sinuses between the lobes; in *D. hirsuta* the branches are connected by thallus-substance, and the sinuses thus appear lunulate. These distinctions would be very helpful if they were at all constant but, in the writer's experience, this is not the case. All gradations occur between strongly bristly receptacles and those with marginal bristles only, while the ridges with their branches, although sometimes fairly distinct, are often vague and evanescent. Neither is there any correspondence between differences in the thallus and differences in the female receptacle. A smooth or nearly smooth form, for example, may bear receptacles with many bristles scattered over the surface or with only a few bristles restricted to the margin.

The characters assigned to the female receptacle of *D. velutina* seem at first sight to be more trustworthy. According to Schiffner (12, p. 26) the disc is depressed-conical with broad lobes and very shallow sinuses, the upper surface bearing few or no bristles. The figures published by Ernst (4, pl. 18, f. 1) and by Campbell (2, text-f. 3) represent the upper surface as perfectly smooth, but otherwise agree with Schiffner's description. In material of *D. velutina* from Java, determined by Campbell, the receptacles agree closely with his figures and show no bristles. This is not the case, unfortunately, with the specimens distributed by Schiffner in his *Iter Indicum*, one of which came from Java (No. 27) and the other from Sumatra (No. 32). In these the immature receptacles are more or less bristly and some of the bristles are scattered over the upper surface. The older receptacles tend to be less bristly, but their marginal sinuses are often deeper than Schiffner's description and the published figures indicate. It would thus appear that the characters assigned to the female receptacle by Schiffner were subject to variation and therefore untrustworthy.

Although the antheridia and archegonia are usually borne on separate receptacles in *Dumortiera*, bisexual receptacles have long been known. They were first described by Taylor (26, p. 391)

in *D. irrigua*, where they seem to be somewhat of a rarity. Ernst, however, demonstrated their frequency in Javan specimens of "*D. trichocephala*" (4, p. 207). He found them also in *D. velutina* but much more rarely and associated this difference with the prevailing monoicous inflorescence of "*D. trichocephala*" and the prevailing dioicous inflorescence of *D. velutina*. Whether or not bisexual receptacles are frequent in American forms of *Dumortiera* remains to be determined.

The spores of *Dumortiera* vary in color from pale to dark brown. The tetrahedral form persists until maturity, although the ridges separating the faces are sometimes difficult to distinguish. The surface-markings are remarkably uniform. Each face bears a series of minute and crowded papillae or short lamellae, which are usually irregularly distributed but which sometimes show a slight tendency to be arranged in short rows. No reticulum is developed. With respect to size statements in the literature are not in accordance. Stephani (25) gives a diameter of $25\ \mu$ for *D. trichocephala* and of $34\ \mu$ for *D. hirsuta*; for *D. velutina* he gives no measurements. Ernst's figures are considerably higher (4, p. 178); he gives a length of $45\text{--}60\ \mu$ and a width of $35\text{--}50\ \mu$, without distinguishing between *D. trichocephala* and *D. velutina*. Campbell (2, p. 329) states that the spores of *D. trichocephala* are about $20\ \mu$ long while those of *D. velutina* are about $29\ \mu$. The writer has examined spores of various forms from widely separated stations and finds that the long diameter measures $20\text{--}30\ \mu$, a considerable range being often present in a single capsule. Apparently little help can be obtained from the spores in the separation of species.

The preceding discussion brings out the untrustworthy nature and inconstancy of certain differential characters which have been employed in defining the species of *Dumortiera*. Those drawn from the size and method of branching of the thallus seem especially unreliable. Those drawn from the female receptacle and the spores are scarcely more satisfactory. On the basis of characters drawn from the structural features of the vegetative thallus, the two following species may be distinguished, and these are the only ones which the writer would recognize at the present time:

- Upper surface of thallus smooth or nearly so throughout (although often showing vestigial air chambers). 1. *D. hirsuta*.
 Upper surface of thallus with crowded papilliform cells, at least in certain portions (always showing vestigial air chambers). 2. *D. nepalensis*.

I. DUMORTIERA HIRSUTA (Sw.) Nees

- Marchantia hirsuta* Sw. Prodr. Fl. Ind. Occid. 145. 1788.
Dumortiera hirsuta Nees, Nova Acta Acad. Leop.-Carol. 12: 410. 1824.
Marchantia irrigua Wils.; Hooker, Brit. Fl. 2: 106. 1833.
Hygropyla irrigua Tayl.; Mackay, Fl. Hibern. 2: 54. 1836.
Dumortiera irrigua Nees, Naturg. Europ. Leberm. 4: 159. 1838.
 ?*Dumortiera hirsuta angustior* G. L. & N. Syn. Hep. 544. 1846.
 ?*Dumortiera hirsuta intermedia* G. L. & N. l. c.
 ?*Askepos brevipes* Griffith, Not. Pl. Asiat. 2: 340. 1849.
Dumortiera hirsuta irrigua Spruce, Trans. Bot. Soc. Edinb. 15: 566. 1885.

It seems unnecessary to give a list of the many specimens which the writer has referred to *D. hirsuta*. They represent a very extensive geographical range, for the most part tropical, and include a few sterile and poorly developed plants, which are not altogether above suspicion. This is especially the case when such plants were found in regions where *D. nepalensis* also occurs. The specimens examined came from the following states, countries, and islands: Pennsylvania, North Carolina, South Carolina, Kentucky, Tennessee, Georgia, Florida, Alabama, Missouri, and Arkansas; Mexico, Guatemala, Nicaragua and Panama; Bermuda; Cuba, Hispaniola, Jamaica, Porto Rico, Montserrat, Guadeloupe, Martinique and Grenada; Colombia, Peru and Bolivia; Venezuela, Brazil and Paraguay; Ireland, England (East Sussex) and France (Hautes-Pyrénées); Madeira and the Canary Islands; Fernando Po and Kamerun; China, India (including Nepal and Ceylon), French Indo-China and Japan; the Philippine Islands, Java and the Hawaiian Islands.

It has unfortunately been impossible to secure the actual type specimen of *Marchantia hirsuta* for examination. The specific name "*hirsuta*" is here associated with the form without surface papillae, because a Swartzian specimen in the British Museum (kindly examined by Mr. Gepp) is smooth and because the

smooth form predominates in the West Indies. Out of over fifty West Indian specimens examined (including fifteen from Jamaica, the type-locality for *M. hirsuta*) only two showed papillae. Of course this evidence is not absolutely conclusive, and if it should ever be proved that the original specimen of *M. hirsuta* represented the papillose form, the synonymy of the species would have to be revised.

There is no such doubt about *Marchantia irrigua*. The Irish specimens of *Dumortiera* are all smooth on the upper surface, with rather vague vestiges of air chambers, and (as Schiffner has shown) never produce papillae even under cultivation. The vars. *angustior* and *intermedia* of the Synopsis need further study. Var. *angustior* was based on Mexican plants with a strongly setulose female receptacle, while var. *intermedia* was based on plants from Peru and South Africa with fewer bristles on the receptacle. Neither of these varieties is known to the writer from authentic material. The same thing is true of Griffith's *Askepos brevipes*, which was based on Indian specimens. Schiffner reduced Griffith's genus to synonymy under *Dumortiera* in 1893 (9, p. 35) but has apparently made no definite reference to its single species. According to Griffith's description and figures *A. brevipes* is clearly a *Dumortiera*. It is here referred to *D. hirsuta*, rather than to *D. nepalensis*, on the basis of one of Griffith's specimens in the Mitten Herbarium. This specimen came from Dehra, India, and is labelled "*Askepos*"; the thallus shows a smooth dorsal surface with vestigial air chambers, and the female receptacle bears scattered bristles.

2. DUMORTIERA NEPALENSIS (Tayl.) Nees

Hygophylla nepalensis Tayl. Trans. Linn. Soc. 17: 392. *pl.* 15, *f.* 2. 1836.

Marchantia trichocephala Hook. Icon. Pl. *pl.* 158. 1837.

Dumortiera nepalensis Nees, Naturg. Europ. Leberm. 4: 169. 1838.

Dumortiera trichocephala Nees, *l. c.* 4: 499. 1838.

Dumortiera hirsuta latior G. L. & N. Syn. Hep. 544. 1846.

Dumortiera hirsuta trichopus Spruce, Trans. Bot. Soc. Edinb. 15: 567. 1885.

Dumortiera velutina Schiffn. Denkschr. Math.-Naturw. Cl. Kais. Acad. Wiss. Wien **67**: 156. 1899.

Dumortiera calcicola Campbell, Ann. Bot. **32**: 334. *pl.* 8 + *f.* 9. 1918.

According to the knowledge at hand the range of *D. nepalensis* includes neither Europe nor Africa; otherwise it corresponds pretty closely with that of *D. hirsuta*. In certain parts of its range, such as the southern United States and the West Indies, it has been rarely collected; in other parts of its range, such as southeastern Asia, it seems to be more abundant. The following specimens have been examined:—

GEORGIA: Forest Falls, Decatur County, 1901, *R. M. Harper 1193a* (apparently mixed with *D. hirsuta*).

FLORIDA: Gainesville and vicinity, 1909, *R. M. Harper 13*; 1915, *N. L. T. Nelson 100*; Pineola, 1918, *J. K. Small*.

MEXICO: Honey, Puebla, 1908, *Barnes & Land 520, 526*; Jalapa, Vera Cruz, 1908, *Barnes & Land 564*.

HONDURAS: trail near Rio Platano, 1903, *P. Wilson 682*.

JAMAICA: near Newhaven Gap, 1906, *A. W. Evans 604*.

PORTO RICO: between Adjuntas and Ponce, 1906, *M. A. Howe 1256*.

COLOMBIA: Bogotá, *W. Weir*.

ECUADOR: near Baños, *R. Spruce* (distributed as *D. hirsuta* var. in Hep. Spruceanae).

PERU: Monte Guayrapurina, *R. Spruce* (distributed as *D. hirsuta* var. *trichopus* in Hep. Spruceanae).

VENEZUELA: near Caracas, 1854, *Burchel*; valley of the Rio Limon, Aragua, 1913, *H. Pittier 6070*.

CHINA: Hongkong, collector unknown.

INDIA: Nepal, 1820, *N. Wallich* (type of *Hygropyla nepalensis*); Sikkim-Himalaya, 1889, *Fathers Decoby & Schaul 321* (determined by Schiffner as *D. velutina*).

FEDERATED MALAY STATES: Taiping Hills, 1912, *D. H. Campbell*.

JAPAN: Uzen, 1888, *M. Miyoshi 4*; Tokio, 1898, *K. Miyake 1*; Kioto, *G. Shimadzu & Co. 12*.

PHILIPPINE ISLANDS: Mt. Banjao, Tayabas Province, Luzon, 1907, *F. W. Foxworthy 2395*; Benguet Subprovince, Luzon, 1901,

E. D. Merrill 7901; 1910, *E. Fénix* 12814; 1907, *A. D. A. Elmer* 8614; Bontoc Subprovince, Luzon, 1910, *Father Vanoverbergh* 875; near the Shibuyan River, Davao District, Mindanao, 1904, *E. B. Copeland* 985.

SUMATRA: foot of Mt. Singalang, 1894, *V. Schiffner* (distributed as *D. velutina* in Iter Ind. 32).

JAVA: Buitenzorg, *F. A. W. Miquel*; same locality, 1894, *V. Schiffner* (distributed as *D. velutina* in Iter Ind. 27); same locality, 1906, *D. H. Campbell*; Tjibodas, Preanger Province, 1894, *V. Schiffner* (distributed as *D. hirsuta* var. *laticornis* in Iter Ind. 24).

BORNEO: Bidi Caves, Bau, Sarawak, 1913, *D. H. Campbell* (type of *D. calcicola*).

HAWAIIAN ISLANDS: without definite localities, *D. Douglas* 71 (type of *Marchantia trichocephala*); 1864-70, *H. N. Bolander*; 1876, *J. Bailey* 1; Honolulu, Oahu, 1892, *D. H. Campbell*; Panoa, Oahu, 1895, *A. A. Heller* 2330; Manoa Valley, Oahu, 1917, *D. H. Campbell*; Oahu, 1918, *H. L. Lyon*; West Maui, 1875, *D. D. Baldwin*.

SAMOAN ISLANDS: Utumapa, Upolu, *C. & L. Reckinger* (distributed as *D. velutina* in Krypt Exsic. Mus. Palat. Vindob. 1391); without definite locality, 1888, *Frances C. Prince*.

The type specimen of *Hygropyla nepalensis* in the Taylor Herbarium shows a thallus with numerous surface papillae associated, as Taylor's figures indicate, with a bristly female receptacle. The type specimen of *Marchantia trichocephala* in the same herbarium shows a thallus with still more numerous papillae and female receptacles which are still more bristly. Both specimens clearly belong to the same specific type. The var. *laticornis* of *D. hirsuta*, which is listed above in the synonymy, was probably an admixture; it was based on specimens from various parts of the world and may have included forms which would now be referred to the true *D. hirsuta*. The var. *trichopus*, however, is undoubtedly a true synonym of *D. nepalensis*, as the specimens distributed by Spruce clearly indicate.

The last two species which are listed among the synonyms have already been discussed to some extent in the preceding pages. *D. velutina* is distinguished from strongly papillose forms of *D. nepalensis* by certain features of the female receptacle, but

these features (according to the evidence at hand) are too inconsistent to be considered of specific value. In *D. calcicola*, as already pointed out, the characters drawn from the size of the thallus and from the sympodia developed by the sexual plants are of little significance. The characters drawn from the immature female receptacles with unfertilized archegonia and from the male receptacles are likewise of doubtful value. Unfortunately the papilliform cells of the thallus are rather scantily developed in the type material, but this condition is often duplicated in undoubted *D. nepalensis*.

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